

NAVIGATION METHOD AND DEVICE

Background Information

The present invention relates to a navigation method and a navigation device, in particular for use in vehicular navigation systems.

Although it is applicable to any information systems having an information supply delivered from an external site or a control center to a plurality of information addressees, the present invention and the problem on which it is based are explained with respect to an on-board navigation system in an automobile and its connection to a central traffic control system.

On-board navigation systems today are composed essentially of the following subsystems: digital road map, computer module for calculating the trip route, position determining device, system administration, vehicle sensors for detecting vehicle movements, input and output units for operation and navigation.

On-board navigation systems are capable of performing route planning according to various criteria autonomously and independently of a traffic control center after input of the starting point and destination. Newer systems are also capable of processing digital traffic information such as that received over RDS-TMC or GSM and calculating detour routes. However, one disadvantage of such a highly developed on-board system is that the detour route for a traffic problem cannot be determined by taking into account the traffic situation on this detour route or on other alternative routes. Furthermore, such systems are incapable of responding in advance to an

altered traffic situation in particular, which is being affected precisely by such rerouted traffic flows.

In addition, there are also known off-board navigation systems in which the intelligence is located in a control center where the route is calculated and transmitted to the vehicle with the help of beacons or wireless telephones (GSM). European Patent 814 448 describes a combined off-board/on-board navigation system. This system is capable of calculating a start-destination route itself like an on-board navigation system. However, to be able to recommend the best possible detour to the driver, taking into account current traffic problems, this publication proposes that the start-destination route be calculated in the terminal while requesting a route from the control center at the same time. The control center then calculates the route, taking into account the current traffic situation and the changed traffic conditions such as those which may occur due to special traffic guidance because of construction sites, etc. After the route is calculated in the control center, a "prediction" is made about how far the user has traveled in the meantime, and then the complete remaining route to his/her destination is transmitted to the terminal.

This method is called a hybrid method because it combines the procedures of on-board systems with those of off-board systems. However, it has the disadvantage that under some circumstances, very large volumes of data must be transmitted, which could result in a heavy load on the wireless network (GSM) when there are multiple users of the system and could also cause high transmission costs in the form of mobile wireless fees. The reason for this is that the complete remaining route beginning with the current location of the vehicle and ending with the programmed destination is transmitted over the mobile wireless network. In the worst case, such a heavy burden on the wireless network might result

in a considerable delay in transmission of data and in an overload of the transmission channel.

Advantages of the Invention

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The method according to the present invention having the features of Claim 1 and the corresponding device according to Claim 4 have the advantage over the known approaches that the load on the wireless network is greatly reduced.

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Advantageous refinements of and improvements on the respective object of the present invention are characterized in the subclaims.

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It is proposed according to the present invention that the data required for optimized route planning, which must be transmitted from a traffic control center to a motor vehicle navigation system, be reduced to a lesser amount. Essentially only the information needed for driving on an alternative section of the route is transmitted. This information represents deviations from the route calculated in the motor vehicle navigation system and is therefore referred to below as delta information. Because of this measure, the entire volume of data to be transmitted remains relatively small even with a large number of users, and thus the cost for each individual remains low.

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The idea on which the present invention is based is essentially to transmit only the information actually needed over the mobile wireless network and also to efficiently utilize the on-board computer resources available in the vehicle for calculation of routes.

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In contrast with strictly off-board methods, according to one aspect of the present invention, when the traffic situation is calm and running smoothly without problems, no data

transmission at all is needed between the traffic control center and the vehicle navigation system, whereas strictly off-board systems must transmit all route information from the starting point to the destination.

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According to a preferred embodiment, the vehicle navigation system delivers the current vehicle position, the route destination and certain database version information to the traffic control center for initiating an optimized route planning. From this information, the control center is able to determine which current traffic problems and possibly even which future traffic problems are to be expected for an individual user of the system. The database version information provides the traffic control center with information regarding which database information is locally retrievable in the vehicle with regard to the various sections of the route and which is processable autonomously there. This minimum of information is sufficient to be able to effectively and rapidly transmit the required information to the vehicle navigation system.

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According to another aspect, however, the method according to the present invention may also be used for specific management of motor vehicle traffic flow. In this case, information is transmitted from a traffic control center to on-board vehicle navigation systems in the respective vehicles for the purpose of preventing traffic problems, in which case if there is a traffic problem and a plurality of feasible detour routes, the traffic flow may be distributed in an intelligent manner not only to one detour but to this plurality of detours.

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According to such a refinement of the present invention, the traffic control center is able to intervene in traffic control to some extent, because not all vehicles need to be guided over the same detour route, and instead all possible reasonable detour routes may be utilized almost uniformly.

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This could be implemented, e.g., by selecting any feature of the user identification as a selection criterion. If a user identification is composed of digits, for example, its end digit could be used to differentiate users and for controlled rerouting into one of the plurality of route sections. Or in the case of end digits between 0 and 3, a detour route A could be proposed to this group of users or, if the digits are between 4 and 6, a different detour route B could be proposed accordingly; otherwise a route C would be proposed. Other options for dividing the group of users would naturally also be possible.

Brief Description of the Drawing

Exemplary embodiments of the present invention are illustrated in the drawing and explained in greater detail in the following description.

Fig. 1 shows a schematic block diagram having the steps that are essential for the inventive method during a trip according to a preferred embodiment,

Fig. 2 shows a schematic diagram having the essential functional elements involved in the inventive method, and

Fig. 3 shows a schematic road map detail.

Detailed Description of the Embodiments

Fig. 1 shows a schematic block diagram having the steps that are essential for the inventive method according to a preferred embodiment during the trip.

In a step 100, the user starts the navigation system at the beginning of his/her trip.

In a step 110, he/she enters the trip destination. Then the vehicle navigation system determines the current location of the vehicle in step 120. In a step 130, the user's preference parameters are input by the system, i.e., whether the user would like to be guided along the fastest route or the shortest route, for example. In this case, the user selects the fastest route.

In a step 140, the on-board navigation system autonomously calculates the route desired by the user with the resources available in the vehicle such as traffic network stored data, e.g., from a database stored on a CD and from a computer.

Then in a step 150, the position of the vehicle, its destination, the preference parameters and a version ID number, characterizing the current version of the database stored in the vehicle navigation system are transmitted to the nearest traffic control center.

At this point, reference is also made to Fig. 2 at the same time. Fig. 2 shows a schematic diagram having the essential functional elements involved in the inventive method. The left portion of Fig. 2 shows the motor vehicle with reference number 20. It has a navigation system 25. The control center referred to above is labeled as 30.

Data transmitted in step 150 by way of mobile wireless communication, including the position, destination, preference parameters and software version number, is indicated as minimum information in Fig. 2 and is shown with reference number 35.

With reference back to Fig. 1, the route for motor vehicle 20 is calculated in a step 155 in the control center, taking into account any possible traffic problems.

If there is no traffic problem which could be relevant for vehicle 20 at the moment or in the near future (see NO branch in decision tree 160), then there is a branch to step 175 where driving instructions from on-board data calculated by navigation device 25 are output to the driver until the destination is reached. Then the method is concluded in a step 180.

However, if a traffic problem which could be relevant for the planned trip of vehicle 20 in the corresponding time window is recorded in control center 30 (see YES branch of decision tree 160), then a detour route for bypassing the problem area is calculated in control center 30, and certain data defining the detour route around the disturbance is compiled for transmission to the vehicle. This delta data or delta information, as it is called, characterizes the detour route so completely that on-board navigation system 25 in vehicle 20 is able to synthesize trip instructions for the driver from this information so that the driver is able to navigate the detour route.

Then in a step 170, the delta data is transmitted to vehicle 20. The delta data is shown with reference number 40 in Fig. 2. The vehicle shown represents the same vehicle in each case. However, two vehicles 20 are shown, because it is moving between steps 150 and 170 (see back to Fig. 1).

In a step 175, the driving instructions obtained by vehicle navigation system 25 from delta data 40 are output to the driver until reaching the original route or the original destination of the trip. It should be pointed out here that after returning to the original route, i.e., after driving the entire detour route, the vehicle navigation system again directs the driver further autonomously and independently of the control center. Then in the remaining course of the route, the same or a different traffic control center may again be

consulted for possible updates of the trip route according to the same principle as that illustrated in Figs. 1 and 2.

With a supplementary reference to Fig. 3, which illustrates a schematic detail of a road map, the method according to a preferred embodiment is described in concrete terms below on the basis of a specific traffic situation.

A vehicle is coming from the direction of Venlo and traveling in the direction of Hannover, but the actual starting and destination points are not relevant in this example.

The optimal route when selecting the "fastest" route here would lead over A2 after the Duisburg-Kaiserberg highway intersection. In the case of a complete blockage 50 on A2 between Bottrop and Gelsenkirchen, one possible alternative route AR1 for an autonomous navigation device would go over A42, starting at the highway intersection at Oberhausen to the highway intersection at Castrop-Rauxel and then over A45 back to A2.

However, the traffic control center is aware that a construction site 52 exists on A42 before Castrop-Rauxel, and although it has not yet created any obstacles, that might be the case under some circumstances due to an increased traffic flow. Therefore, certain delta information for an alternative route AR2 is transmitted to the vehicle navigation system, and then by reading and optionally further processing this information, the vehicle navigation system is able to suggest driving along an alternative route AR2 from the Oberhausen highway intersection over A42 to the Herne highway intersection and then over A43 to Recklinghausen and back to A2.

If there is already too much traffic on this road section, a portion of it could be directed as described and another

portion could be directed along an alternative route AR3 starting at the Duisburg-Kaiserberg highway intersection, then over A40 to the Dortmund-West highway intersection and then over A45 back to A2, i.e., not over A43 from the Essen highway intersection to Recklinghausen because there would be too much traffic at construction site 52 and on A43 between Herne and Recklinghausen.

As more vehicles are equipped with such systems, it will then be more feasible to influence traffic in the sense of managing it through a control center in a better and more comprehensive manner.

Although the present invention has been described above on the basis of a preferred embodiment, it is not limited to this embodiment, but instead it may be modified in a variety of ways.

For example, data transmitted from the vehicle to the control center or from the control center to the vehicle could also be compressed by a conventional method to further reduce the volume of data to be transmitted.

The inventive method is also nestable in many stages in the sense that in the case of two-stage nesting, for example, it would be possible to put through and process the delta data for a tertiary detour route leading away from the primary main route for which a secondary detour route has been already proposed.